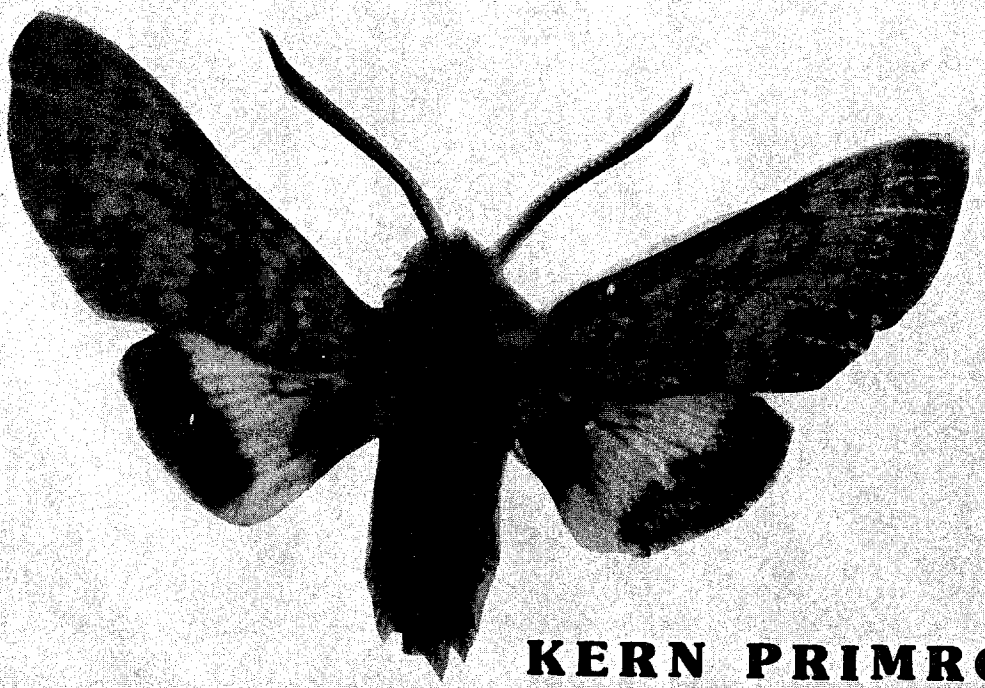
Recovery Plan



KERN PRIMROSE SPHINX MOTH

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RECOVERY PLAN

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Kern Primrose Sphinx Moth

1. Point or condition when species can be considered recovered.

When the single known colony is protected and three more colonies are secure on a combined total of 5000 acres within the Walker Basin.

2. What must be done to reach recovery?

Utilize laws and regulations to protect the moth, protect and enhance existing moth populations, establish additional colonies in the Walker Basin, and gain public support for the recovery of the moth through education and information.

3. What specifically must be done to meet the needs of #2?

A) Patrol known habitat during flight season.
B) Develop and implement strategy to minimize pupal/larval mortality.
C) Increase availability of important native nectar sources.
D) Examine population and limiting factors that relate to habitat protection strategies.
E) Protect habitat.
F) Conduct habitat surveys.
G) Develop captive propagation and translocation techniques.
H) Conduct informational meetings.
I) Distribute audio-visual program for schools.

THIS IS THE COMPLETED KERN PRIMROSE SPHINX MOTH RECOVERY PLAN. IT HAS BEEN APPROVED BY THE U.S. FISH AND WILDLIFE SERVICE. IT DOES NOT NECESSARILY REPRESENT OFFICIAL POSITIONS OR APPROVALS OF COOPERATING AGENCIES AND IT DOES NOT NECESSARILY REPRESENT THE VIEWS OF ALL INDIVIDUALS WHO PLAYED THE KEY ROLE IN PREPARING THIS PLAN. THIS PLAN IS SUBJECT TO MODIFICATION AS DICTATED BY NEW FINDINGS AND CHANGES IN SPECIES STATUS AND COMPLETION OF TASKS DESCRIBED IN THE PLAN. GOALS AND OBJECTIVES WILL BE ATTAINED AND FUNDS EXPENDED CONTINGENT UPON APPROPRIATIONS, PRIORITIES, AND OTHER BUDGETARY CONSTRAINTS.

ACKNOWLEDGEMENTS SHOULD READ AS FOLLOWS:

The Kern Primrose Sphinx Moth Recovery Plan, dated February 8, 1984, prepared by the U.S. Fish and Wildlife Service under contract with Dr. Paul Tuskes, Berkeley, California.

Additional copies may be obtained from:

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Photography courtesy of Clint Kellner, El Cerrito, California

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4. What management/maintenance needs have been identified to keep the species recovered?

Proper management and protection should be continued, translocation sites monitored and yearly population monitoring should take place. Public education and law enforcement efforts should be continued.

Kern Primrose Sphinx Moth Recovery Plan

PART I INTRODUCTION

Brief Overview

The Kern primrose sphinx moth *Euproserpinus euterpe* [Lepidoptera: Sphingidae], is known to occur only in one small area of approximately 6.1 ha. (5 acres) in the Walker Basin of Kern County, California, and was thought to be extinct prior to its rediscovery by Mr. Chris Henne in 1974. The U.S. Fish and Wildlife Service listed *E. euterpe* as a threatened species in 1980 [*Federal Register* 45(69):24088].

This recovery plan provides current information on the life history, past and present distribution, and factors which are believed to influence the population dynamics of the moth. In addition, the requirements of the moth's host plant, evening primrose (*Camissonia* sp.), and habitat are discussed. The plan outlines a program designed to delist the species through maintenance of the present population, establishing three more secure populations, and gathering additional information. It specifies actions required to effect the moth's recovery and maintenance.

Taxonomy

The Kern primrose sphinx moth is one of three distinct species in the genus *Euproserpinus*; the other two species are *E. wiesti*

and E. phaeton (Hodges 1971). E. wiesti is also a rare species with only a few known colonies. Of the three species, E. phaeton is the most commonly observed and until recently was the only member of the genus whose biology was known (Comstock and Dammers 1935). The adults and immature stages of E. euterpe are quite different from those of its closest relatives and preclude generalization from information available about its congeners (Tuskes and Emmel 1981). E. phaeton also occurs in Kern County, however, there is no evidence to indicate that it and E. euterpe occur sympatrically.

Life History

The flight season of the Kern primrose sphinx moth extends from late February to early April with the peak period during mid-March (Tuskes and Emmel 1981). Moths emerge from the pupae in the morning, expand their wings and begin to fly by mid-morning. During the morning, males and females frequently bask on bare patches of soil, dirt roads or the mounds of beechy ground squirrel (Spermophilus beecheyi) and gopher (Thomomys bottae) to warm their flight muscles as daytime temperatures during the flight season range from 45° F to 70° F. Most nectaring occurs in the morning at flowers of filaree (Erodium cicutarium), and baby blue-eyes (Nemophila menziesii). Few insects visit the nectar sources in the afternoon. By afternoon the nectar may be exhausted or wind speed too high for insect flight. As the day progresses and temperatures rise, males become active fliers and are difficult to observe and capture.

Mating usually occurs prior to noon and ovipositing females are generally observed between late morning and early afternoon. Females fly low to the ground and deposit 1 or 2 eggs on the underside of the evening primrose and filaree leaves. Oviposition on filaree presents a significant problem as the larvae do not feed on the plant and subsequently starve. The eggs are light green and measure 1 x 1.1 mm. At least 11 days are required for the eggs to hatch. There are 5 larval instars before pupation occurs in May. The adults may emerge the following year or may remain in the pupal stage for an undetermined number of years. It is not known how long pupae can survive. The detailed life history and immature stages of E. euterpe are described by Tuskes and Emmel (1981).

Habitat Description

The Walker Basin is at an elevation of 1,470 m in the southern Sierra Nevada of Kern County, California. The basin is surrounded by mountains over 2000 m in elevation. Currently, a large portion of the basin is devoted to agriculture (primarily barley cultivation and cattle pasture). The dominant vegetation in the sandy washes in which the colony occurs includes filaree, baby blue-eyes, and rabbit brush (Chrysothamnus nauseosus), as well as gold fields (Lasthenia chrysostoma) and Brome grass (Bromus arenarius). The soil originates from decomposed granite and is largely alluvial in nature. Its texture is coarse to fine sand with very little silt.

The annual evening primrose, on which the larvae of Kern primrose sphinx moths feed, occurs in dry, disturbed and sandy-gravelly areas below 3000 m in many plant communities from Oregon to Baja California. Since the 1969 revision of the genus Camissonia the taxonomic status of the host plant is unclear and it is possible that this moth is able to utilize several sympatric and closely related Camissonia species. In the Walker Basin, the evening primrose is frequently found along the edge of sandy washes adjoining fallow fields. Seeds begin to germinate in February and March, but the young seedlings are frequently difficult to locate and identify during the flight season of the moth.

At the sphinx moth site in 1983 (Kellner, pers. comm.*), the food plant was patchily distributed. In some of the patches it was found associated with Lindley's annual lupine (Lupinus bicolor) and filaree and not in association with high densities of gold fields.

In 1962 the Kern primrose sphinx moth site was first plowed and rock removed. It was planted in grain, and maintained until 1975 when the drought killed the grain crop. Since 1975 cattle have grazed the site. Between 1962 and 1975 the site was disked five times. In the 1960's there was a big flood in the wash that forms the north border

* Mr. Clinton Kellner, University of California-Davis, Davis, California 95616

of the site. The wash was then dredged and channelled to hold more water during spring high water (Rick Hewitt, pers. comm*).

The plant community surrounding the basin floor is dominated by juniper (Juniperus californica), oak (Quercus douglassii, Q. turbinella, Q. wislizenii), rabbitbrush (Chrysothamnus nauseous), sagebrush (Artemesia sp.), and pine (Pinus monophylla). The distribution of the moth may be limited because the host plant does not occur in these plant communities. South of the basin the plant community is oak-grassland and appears unsuitable for the moth.

Winter conditions in Walker Basin include wind, rain, hail and snow with temperatures often below freezing during the time the moth is in the pupal stage. Adults and the newly hatched larvae are active in the spring when there is a gradual warming trend. Winter rains usually end by mid-April. The summer months are dry and hot. The host plant has usually gone to seed and dried out by early or mid-June.

Past and Present Distribution

From the time of the rediscovery of the moth in 1974 until the present, the only known colony of Kern primrose sphinx moth has been in extreme northwest portion of Walker Basin, Kern County,

* Mr. Rick Hewitt, Land Steward Kern River, The Nature Conservancy.

California. In 1979, the strongest portion of the colony appeared to be centered on a sandy patch of soil between a wash and a fallow barley field. Other colonies may occur in the basin, but to date all moths have been found within a 3 km radius of the original colony. During the 1983 survey, no moths were found, however.

The type specimen of E. euterpe was collected by H. K. Morrison and was given to Henry Edwards to describe. Edwards (1888) gave the type locality as San Diego County; however, this is certainly incorrect. Edwards published so many incorrect type localities for material he received from Morrison that Morrison felt compelled to publish a short note in 1883 correcting the errors Edwards had made. Unfortunately Morrison died in 1888 prior to the description of E. euterpe. Two of his 1883 corrections are of special interest for they are for a moth and butterfly collected near the present Kern primrose sphinx moth colony. These and other records (Hoover et al. 1966, Morrison 1883) indicate that Morrison passed through the Walker Basin on his way to the Kern River during the flight season of E. euterpe. In addition, intensive collecting in San Diego County by many collectors has failed to locate the species there. Kern primrose sphinx moth may have been confined to the Walker Basin even at the time of its original discovery (Figure 1).

Limiting Factors and Threats

Human activity probably has affected the population levels of the Kern primrose sphinx moth in at least three ways: (1) the introduction

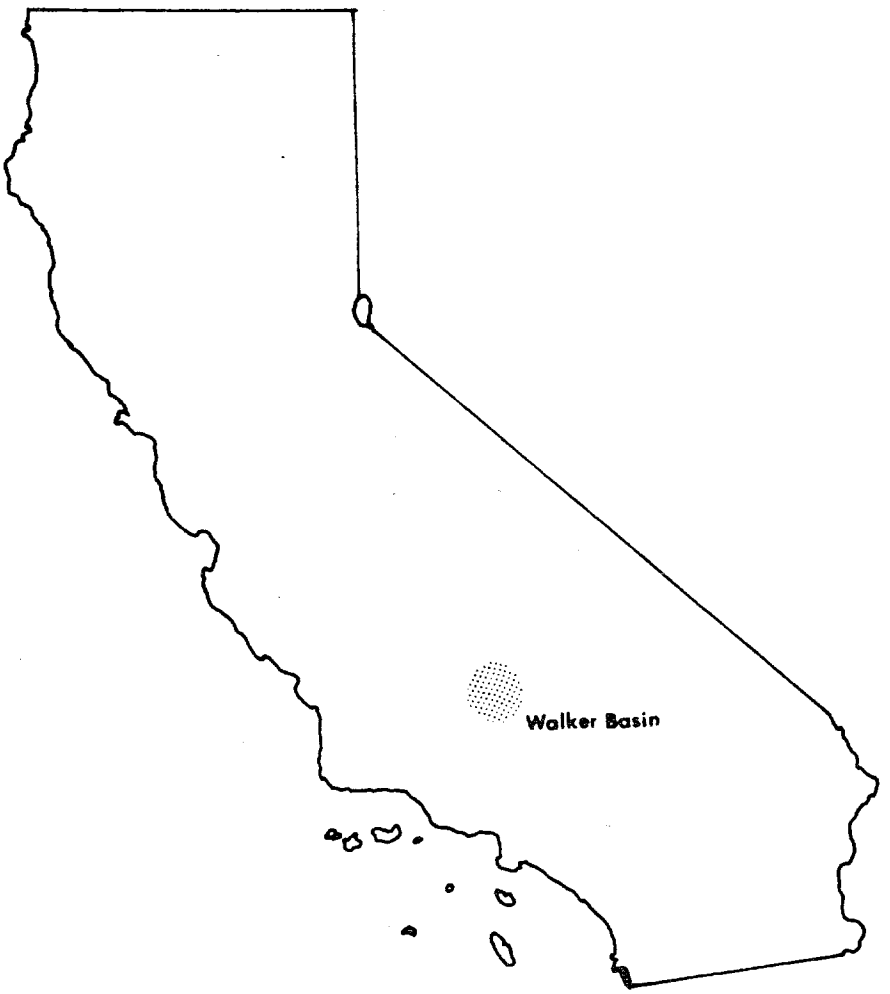

Figure 1. Generalized locality of Kern Primrose Sphinx Moth Colony. Specific locality is not included because of collection pressure.

and establishment of non-native plants may have had a significant impact on the ability of the moth to locate and oviposit on the correct host plant; (2) land use practices probably have directly influenced the survival of the moth and/or its host plant; and (3) flight characteristics of the moth result in collectors capturing a greater proportion of females than males which adversely affects the population's reproductive potential.

Female moths consistently deposit eggs on the filaree, a naturalized exotic plant. Filaree was introduced to California with the arrival of the Spanish. Records indicate that by 1775 it was well established from San Francisco to Baja California (Hendry and Bellue 1936, Robbins 1940). Larvae hatched from eggs deposited on filaree do not feed and die of starvation after a few days. Such ovipositional errors may be a significant factor in reproductive success and subsequently contribute to the scarcity of the moth.

Land use practices are the second major threat to the population. Evening primrose occurs in sandy soil along washes and in fallow fields in somewhat ruderal habitat. Much of the land in the Walker Basin that was appropriate habitat for the moth has been developed for agricultural purposes, and is used as crop land or pasture for cattle. In 1974, a portion of a fallow field served as part of the colony site. Since the rediscovery of the moth the field has not been plowed and it appears that the host plant is becoming less common in that area, possibly because of succession to plants better suited to a more

stable habitat. Other agricultural practices such as the application of pesticides and herbicides or channeling of washes could adversely effect the moth and its host plant. E. wiesti was shown to be negatively affected by drift from aerial application of insecticide (Bagdonis, pers. comm.*). The potential exists for causing accidental extirpation of the moth.

The Kern primrose sphinx moth site is currently grazed. Grazed sites in the basin typically have high densities of filaree, rabbitbrush and in some cases, goldfields and Lindley's annual lupine. The food plant may be present in these grazed areas in scattered dense aggregations, but it is not common in grazed areas. Dry farming for barley may be better for the moth than grazing because the fields are not generally plowed every year. Instead they are drilled and planted. Dry farming, therefore, probably would disturb sphinx moth colonies less than grazing.

Collection of the moth is a concern. For the first 5 years after its rediscovery, the Kern primrose sphinx moth was observed only in one small area. Intensive collecting during the flight seasons resulted in the capture of at least 27 moths during this period. No collections were made by researchers. In 1979 the moth was observed to be more abundant in the area surrounding the original colony and 47 specimens were collected. Because the colony is so restricted, it is

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subject to over-exploitation by collectors. Prior to the 1980 listing of the animal, 74 specimens were known to be collected during a six year period. Of the total, 54 (73%) were females (Tuskes, unpubl. obs.).

The difference in the sex ratio of captured moths resulted because females fly slower than males and stop to oviposit, thereby making them easier to collect. The capture of 54 females probably represents a loss of over 1600 eggs. If the locality of the moth were more widely known to collectors, the impact would probably have been even greater. By listing the moth as threatened, it was hoped that the problem of illegal collection would lessen. The problem still exists because of the high monetary value of the Kern primrose sphinx moth to both commercial and private collectors.

Conservation Efforts

No overt actions have been taken to preserve or protect the Kern primrose sphinx moth. Legal protection against "taking" the moth is afforded only by its listed status. This prohibition is especially important considering the extremely limited size of the colony.

A field survey was completed in the spring of 1983 by C. Kellner where efforts were made to more completely define the Kern primrose sphinx moth habitat preferences. Because of poor weather conditions, however, the moths were not observed. This may reflect low emergence

rates because of the poor weather, normal population fluctuations or some other factor such as a very short flight season. So little is known of this species that it is difficult to speculate on the reasons for no moths being observed since 1980.

PART II

RECOVERY

Objectives

The prime objective of this recovery plan is to delist the species by protecting the only presently known colony of the Kern primrose sphinx moth and establishing three more secure colonies within the Walker Basin, with a combined total of 5,000 acres that are secured by easement, long-term agreement or other protective strategy. Also, each of these colonies should be maintained without threat from agricultural conversion, pesticides, disease or collection for a period of ten consecutive years before delisting should be considered.

The major premise of this recovery plan is that full recovery and ultimate delisting of the Kern primrose sphinx moth can only be achieved by restoration and maintenance of the ecosystem upon which it depends. This is the primary purpose of the Endangered Species Act of 1973, as amended. Before this ecosystem can be restored, however, many preliminary actions to secure the present colony need to be taken and much information concerning the moth and its host plant needs to be ascertained.

Enforcement of the "taking" provisions of the recently amended Endangered Species Act is essential, as is protection of the only

presently known colony. So little is known about the biology and requirements of the moth and its habitat, that ecological and life history studies must be undertaken before establishment of additional colonies can be considered.

Step-down Outline

The prime objective of this recovery plan is to delist the species by protecting the present colony of the Kern primrose sphinx moth and establishing three more secure colonies within the Walker Basin, with a combined total of 5000 acres that are secured by easement, long-term agreement or other protective strategy. Also, each of these colonies should be maintained without threat from agricultural conversion, pesticides, disease or collection for a period of ten consecutive years before delisting should be considered.

1. Utilize laws and regulations to protect Kern primrose sphinx moth.
   - 11. Patrol known habitat during flight season.
   - 12. Enforce applicable State and Federal laws.
   - 13. Evaluate effectiveness of applicable laws and regulations and propose modifications as necessary.

2. Protect and enhance existing Kern primrose sphinix moth populations.
   - 21. Develop and implement strategy to minimize pupal/larval mortality.
     - 211. Promote correct oviposition behavior.
       - 2111. Analyze extent and effect of use of filaree for oviposition.

2112. Select and implement methods to encourage correct oviposition.

21121. Assess alternatives to augment host plant availability.

21122. Assess methods to control filaree.

211221. Test use of herbicides.

211222. Test physical removal of filaree.

211223. Test the effects of livestock grazing on filaree dominated areas.

212. Determine if larvae move from filaree to host plant.

213. Assess extent of predation, parasitism, disease, and other mortality factors on sphinx moth larvae.

214. Investigate requirements of sphinx moth pupae.

22. Increase availability of important native nectar sources.

221. Determine native species to be planted.

222. Plant selected native nectar sources.

23. Examine population-limiting factors that relate to habitat protection strategies.

231. Conduct annual survey of present and potential moth habitat and relate to possible relationships of naturally occurring physical and biological factors on sphinx moth population fluctuations.

232. Examine effects of grazing and agricultural development (i.e., pesticide use).

24. Develop strategy to protect habitat.

241. Pursue management agreement with local landowners to reduce adverse effects of pesticide use.

242. Secure habitat through development and implementation of a land protection plan.

3. Establish additional colonies of Kern primrose sphinx moth in the Walker Basin.

31. Conduct habitat surveys to determine possible translocation sites.

32. Develop and implement a land protection plan(s).

33. Develop captive propagation techniques, if necessary.

34. Develop translocation techniques.

35. Implement transplant action.

36. Monitor transplanted populations.

4. Inform public about Kern primrose sphinx moth and its habitat.

41. Conduct informational meetings.

42. Distribute audio-visual program for schools.

43. Prepare and distribute local press releases.

Narrative

1. Utilize laws and regulations to protect Kern primrose sphinx moth.

Law enforcement is an important part of recovery as collection is a great threat to the species.

11. Patrol known habitat during flight season.

In order to prevent taking of the moth, a daily patrol of the colony in late morning and early afternoon should be instituted during the flight season (approximately 6 weeks).

12. Enforce applicable State and Federal laws.

Other State, Federal or local laws and regulations may be of use in protection of the Kern primrose sphinx moth. These may include pesticide regulation, permissible land use as well as trespass and procedural regulation in association with environmental review of local land use actions at the county level.

13. Evaluate effectiveness of applicable laws and regulations and propose modifications as necessary.

A yearly assessment of the effectiveness of existing laws for protection of the Kern primrose sphinx moth and suggestions for improvements in the laws and regulations should be made. If any modifications in existing laws or

regulations are deemed appropriate, they should be proposed to appropriate legislators or regulatory agencies.

2. Protect and enhance existing Kern primrose sphinx moth populations.

In order to protect and enhance Kern primrose sphinx moth populations, a variety of activities should be undertaken. Control of filaree, and augmentation of host plant and native nectar sources are important. The habitat should be secured from destructive activities such as grazing, adverse agricultural use and pesticide effects. Research is needed to determine aspects of life history which are important to management strategies for enhancement of sphinx moth populations.

21. Develop and implement strategy to minimize pupal/larval mortality.

A strategy incorporating the ecological needs of all stages of the sphinx moth is needed in order to minimize pupal/larval mortality. Oviposition considerations are important and may include actions as diverse as host plant augmentation or physical removal of filaree. This strategy can not be developed, however, without basic research on many aspects of the ecology of the moth. Those chosen here represent a minimum of information needed to develop this strategy. Once additional information is available, management needs will become clearer.

211. Promote correct oviposition behavior.

In order to promote correct oviposition behavior, an understanding of the interaction between the moth and the host plant is needed. Interactions among members of the plant community and physical and biological factors are also important to understand before large scale management activities for promotion of correct oviposition are undertaken.

2111. Analyze extent and effect of use of filaree for oviposition.

Eggs deposited on filaree (a naturalized exotic plant) do not survive. In 1979, Tuskes and Emmel observed that the females commonly oviposited on filaree rather than the correct host plant, evening primrose. Ovipositional studies of moths in cages and additional field observations are needed to determine the effect of such ovipositional errors on the Kern primrose sphinx moth's reproductive capacity.

Laboratory experiments on the oviposition behavior of Kern primrose sphinx moth are necessary to direct the research performed in the field. These should include observations of oviposition behavior with differential densities

of evening primrose and filaree. A certain density of host plant may be required in order to elicit an oviposition response. Such data would best be obtained under controlled laboratory conditions.

The response of moths to stimuli may be different in the field than in the laboratory. Wind speed, direction, temperature as well as other factors may be significant in determining ovipositional responses. Behavioral field studies similar to those conducted in the laboratory should be made to determine if the responses vary significantly.

2112. Select and implement methods to encourage correct oviposition.

Because present Kern primrose sphinx moth habitat has been altered by man's introduction of plants and utilization of land, a management program is necessary to return the vegetation where the Kern primrose sphinx moth occurs to high quality habitat. This may be accomplished by a simple addition of host plant seed, but more likely would involve a combination of filaree suppression and evening primrose augmentation.

21121. Assess alternatives to augument host plant availability.

Augmentation of evening primrose numbers may be necessary in order to increase the probability of oviposition on the proper host plant. This may prove to be a more viable alternative than many of the filaree control methods discussed below.

Local seed sources are very important for the evening primrose as it is very difficult to distinguish from other species of this group. Maintenance of the proper primrose genetic material is essential to the sphinx moth and strict controls on planting materials should be set.

The field-collected seed should be propagated and seed should be collected from the first generation of offspring. A certain proportion of wild collected seed should be included in order to prevent a horticulturally selected seed source from developing. Host plant augmentation should be tested in plots

with different grazing regimes, filaree control regimes and in unmanaged areas.

21122. Assess methods to control filaree.

Filaree may respond to a variety of control/management schemes which would reduce its predominance in the sandy washes where the Kern primrose sphinx moth occurs.

211221. Test use of herbicides.

Herbicides which act only on actively growing plants could be utilized to control the filaree. The life cycle of the plant is such that herbicides could be applied when only filaree is active. Tests to determine the potential toxicity of the herbicide to all stages of the moth's life cycle should also be completed before any herbicide is used to control filaree.

211222. Test physical removal of filaree.

It may be possible to physically remove filaree in selected Kern

primrose sphinx moth habitat. This would be highly labor intensive work and probably would not be a viable filaree control alternative for management of large tracts of moth habitat.

211223. Test the effects of livestock grazing on filaree dominated areas.

Filaree domination of the annual plant community such as at the Kern primrose sphinx moth colony can be a result of livestock grazing. Research could include exclosures and an examination of the effects of different species of livestock on the filaree density and vigor.

Several test treatments of filaree dominated areas should be made to determine the effects of grazing.

212. Determine if larvae move from filaree to host plant.
Larvae that hatch from eggs laid on filaree may be able to move to the appropriate host plant and successfully feed. The ability of larvae to do this in different densities of filaree and host plant should be determined. This may have significant ramifications on any vegetation management program undertaken.

213. Assess extent of predation, parasitism, disease and other mortality factors on sphinx moth larvae.
Presently nothing is known about the effects of predators and parasites on the Kern primrose sphinx moth. This needs investigation.

214. Investigate requirements of sphinx moth pupae.
The effect of disturbance on overwintering pupae may be important in the context of preserve design and vegetation management. In order to avoid inadvertent destruction of larvae and pupae during vegetation management actions, the factors contributing to the successful feeding of larvae and overwintering and emergence of pupae must be determined.

22. Increase availability of important native nectar sources.
The moth may utilize filaree as an important nectar source. If filaree were to be removed, it would be important to know

what effect such removal would have on energy availability during the flight season.

It may be possible to augment nectar sources in the event of a filaree control program. Added seed of baby blue-eyes combined with removal or suppression of filaree may result in no net reduction of the nectar supply available to the moths.

Other native plants adapted to this kind of site should be investigated as other nectar augmentation sources in the event of filaree removal.

221. Determine native species to be planted.

Several native plant species are potential nectar replacement sources in the event that filaree is eradicated. These include baby blue eyes and Lupinus bicolor.

222. Plant selected native nectar sources.

Seed to augment nectar sources should be collected locally within the Walker Basin and scattered in the autumn before the winter rains begin.

23. Examine population-limiting factors that relate to habitat protection strategies.

Little is known about the requirements for a healthy,

vigorous colony of Kern primrose sphinx moth. Much information needs to be collected in order to establish new colonies and protect the existing colony.

231. Conduct annual survey of present and potential moth habitat and relate to possible relationships of naturally occurring physical and biological factors on sphinx moth population fluctuations.

Annual plant densities and percent composition in a plant community often fluctuate widely from year to year. Many factors may be responsible for these fluctuations, however, climatic conditions often are a good indicator of which plants will dominate in the particular year. An annual sphinx moth survey should be conducted and an analysis should be done of the survey and utilized to determine the effect of natural phenomena on yearly population levels.

An evaluation of the distribution of Kern primrose sphinx moth in relation to climatic and elevational factors is needed. Distribution of the moth may be tied to soils and autecological requirements of the host plant. There may also be pupal requirements which can only be met at certain elevations or in patchily occurring microclimates.

232. Examine effects of grazing and agricultural development (i. e., pesticide use).

Much work is needed to determine areas in the Walker Basin which are presently suitable for Kern primrose sphinx moth. It is curious that the only known colony occurs in what was previously an active barley field. This would seem to indicate that there are areas in the Walker Basin that, if taken out of crop production, could revert to suitable Kern primrose sphinx moth habitat.

Livestock grazing exclosure studies are often a good way of determining the effect of large grazing animals on a plant community. Such studies may show that a grazing management plan is necessary as opposed to total removal of grazing. Grazing may aid in maintenance of an early seral community that is needed by the host plant and suppression of non-native annual grasses.

24. Develop strategy to protect habitat.

In order to protect Kern primrose sphinx moth habitat, reduction of any deleterious effects to the moth from aerial pesticide application is essential. In addition, it is necessary to secure control and manage the one presently known Kern primrose sphinx moth colony.

241. Pursue management agreement with local landowners to reduce adverse effects of pesticide use.

The utilization of aerial - broadcast pesticide for agriculture in the Walker Basin could have had a significant effect on the population numbers of the moth. It may be possible to persuade local farmers to agree to a moratorium on aerial pesticide application during the flight season of the moth. Aerial application of broad spectrum insecticides may not be absolutely necessary to the operations of local farms and ranches. In the event that farmers would be asked to cease this kind of pesticide use, expertise within the Service should be provided to help local farmers control pests while aiding the recovery of the species.

242. Secure habitat through development and implementation of a land protection plan.

All avenues of protection for privately owned Kern primrose sphinx moth habitat should be explored by the Fish and Wildlife Service during the preparation of a land protection plan.

Implementation of a land protection plan for the Kern primrose sphinx moth is a major requirement for eventual delisting of this species.

3. Establish additional colonies of Kern primrose sphinx moth in the Walker Basin.

Data from a recent (1983) (Kellner, pers. comm.) survey of the Walker Basin show that there is more potential habitat for the moth in Walker Basin than was previously believed. Three additional colonies should be established within the basin in order to reduce the probability of extinction.

31. Conduct habitat surveys to determine possible translocation sites.

A habitat survey should be made for possible sites where appropriate habitat could be secured and managed effectively.

32. Develop and implement a land protection plan(s).

In order to delist the species, the Kern primrose sphinx moth habitat must be secured. Development and implementation of a land protection plan is central to securing this habitat.

33. Develop captive propagation techniques, if necessary.

Techniques for captive propagation for translocation stock are probably needed. Development of these techniques will probably require several years. It may require another 3 years to raise enough individuals to establish new colonies.

34. Develop translocation techniques.

Translocation techniques may require several years in

addition to developing captive propagation techniques. It will also probably require at least 3 to 5 years before a translocation attempt can be determined to be successful and secure.

35. Implement transplant action.

Establishment of translocations will be labor intensive over a time period ranging from 3 to 5 years. However, if a banner year for larvae occurs, it may be possible to translocate larvae to a new site for establishment of a new colony. This technique may not be feasible without a large population.

36. Monitor transplanted colonies.

Annual surveys of the transplanted colonies are needed in order to determine the success of this action. Analysis of the plant community in and surrounding the new colonies should be made to determine whether vegetation management actions should be undertaken. Surveys will be necessary for an extended period of time.

4. Inform public about Kern primrose sphinx moth and its habitat.

The residents of Walker Basin should be informed of the moth's uniqueness to solicit their support for the recovery program. Actual locations of colonies will not be included in the public affairs information.

41. Conduct informational meetings.

Informational meetings to increase local awareness of the Kern primrose sphinx moth and other unique resources should be arranged. Local support of conservation of the species is necessary for protection of this and other endangered and threatened species.

42. Prepare and distribute audio-visual program for schools.

An audio-visual program concerning endangered and threatened species which may include the Kern primrose sphinx moth should be distributed for use in schools throughout the State.

43. Prepare and distribute local press releases.

News releases printed in the local papers concerning this moth and other endangered species can contribute significantly to positive public opinion toward species conservation and the Endangered Species Act.

Literature Cited

Comstock, J. A. and C. M. Dammers. 1935. Notes on the early stages of three butterflies and five moths from California. Bull. Co. Calif. Acad. Sci. 33:137-151.

Edwards, H. 1888. Euproserpinus euterpe a new species of Sphingidae. Ent. Americana 4:25-26.

Hendry, G. W. and M. K. Bellue. 1936. An approach to southwestern agricultural history through adobe brick analysis. Univ. New Mexico Bull. 296. pp 65-72.

Hodges, R. W. 1971. Sphingoidea: Sphingidae. Moths of North America, North of Mexico, Fascicle 21; p. 158, pl 4.

Hoover, M. D., H. E. Rensch, and E. G. Rensch. 1966. Historic spots in California. Stanford Univ. Press. Stanford, Calif.

Morrison, H. R. 1883. Localities for diurnals. Papilo 3:43.

Robbins, R. M. 1940. Alien plants growing without cultivation in California. Univ. Calif. Agr. Expt. Sta. Bull. 637.

Tuskes, P. M. and J. F. Emmel. 1981. The life history and behavior of Euproserpinus euterpe (Sphingidae). J. Lep. Soc. 35:27-33.

PART III

IMPLEMENTATION SCHEDULE

A summary of scheduled actions and costs for the Kern primrose sphinx moth recovery program is presented in Table 1. It is a general guide to meet the objectives of the Kern Primrose Sphinx Moth Recovery Plan, as elaborated upon in Part II. When the tasks identified by this plan have been accomplished the continued survival of this threatened species will be assured.

GENERAL CATEGORIES FOR IMPLEMENTATION SCHEDULES

Information Gathering - I or R (research)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management techniques
5. Taxonomic studies
6. Demographic studies
7. Propagation
8. Migration
9. Predation
10. Competition
11. Disease
12. Environmental contaminant
13. Reintroduction
14. Other information

Aquisition - A

1. Lease
2. Easement
3. Management agreement
4. Exchange
5. Withdrawal
6. Fee title
7. Other

Management - M

1. Propagation
2. Reintroduction
3. Habitat maintenance and manipulation
4. Predator and competitor control
5. Depredation control
6. Disease control
7. Other management

Other - O

1. Information and education
2. Law enforcement
3. Regulations
4. Administration

RECOVERY ACTION PRIORITIES

1. Priority 1. An action that must be taken to prevent extinction or to prevent the species from declining irreversibly.

2. Priority 2. An action that must be taken to prevent a significant decline in species population/habitat quality, or some other significant negative impact short of extinction.

3. Priority 3. All other actions necessary to provide for full recovery of the species.

PART III IMPLEMENTATION SCHEDULE

Kern Primrose Sphinx Moth

General Category	Plan Task	Task Number	Priority Number	Task Duration (Years)[1]	Responsible Agency* FWS Region	FWS Program	Other Agency	Estimated Costs[2] ($1,000) FY1	FY2	FY3	Comments/Notes
02	Patrol known habitat during flight season	11	1	Continuous	1	LE*		10	10	10	
							CDFG	3	3	3	
02	Enforce applicable State and Federal laws	12	1	Continuous	1	LE*		2	2	2	
							CDFG	2	2	2	
03	Evaluate effectiveness of applicable laws and regulations	13	3	As needed	1	LE SE*		To be determined			
I3	Analyze extent and effect of use of filaree for oviposition	2111	2	2	1	SE*		5	5		
							CDFG	5	5		
M7	Assess alternatives to augment host plant availability	21121	2	As needed	1	SE*		2	2	2	
							CDFG	1	1	1	

General Category	Plan Task	Task Number	Priority Number	Task Duration (Years)[1]	Responsible Agency* FWS Region	FWS Program	Other Agency	Estimated Costs[2] ($1,000) FY1	FY2	FY3	Comments/Notes
M2	Test use of herbicides to control filaree	211221	2	3	1	SE*		1	1	1	
M3	Test physical removal of filaree	211222	2	3	1	SE*			2	2	
M7	Test the effects of livestock grazing on filaree dominated areas	211223	2	3	1	SE*			2	2	
							CDFG		2	2	
I3	Determine if movement by larvae from filaree to host plant is possible	212	2	1	1	SE*			2		
							CDFG		1		
I10	Assess extent of predation, parasitism, disease and other mortality factors on sphinx moth larvae	213	2	3	1	SE*				3	
							CDFG			3	
I14	Investigate requirements of the sphinx moth pupae	214	2	2	1	SE*			2	2	
							CDFG		2	2	

General Category	Plan Task	Task Number	Priority Number	Task Duration (Years)[1]	Responsible Agency* FWS Region	FWS Program	Other Agency	Estimated Costs[2] ($1,000) FY1	FY2	FY3	Comments/Notes
I4	Determine native species to be planted as nectar sources	221	2	1	1	SE*	CDFG			2	
I4	Plant selected native nectar sources	222	2	As needed	1	SE*	CDFG		To be determined		
I4	Conduct annual survey of present and potential sphinx moth habitat and relate to relationships of naturally occurring physical and biological factors on sphinx moth population fluctuations	231	1	5	1	SE*	CDFG		3 1	3 1	
I2	Examine effects of agricultural grazing and development	232	2	2	1	SE*	CDFG			2 2	
M3	Pursue management agreement with local landowners to reduce adverse effects of pesticide use	241	1	2	1	SE*	CDFG			3 3	

General Category	Plan Task	Task Number	Priority Number	Task Duration (Years)[1]	Responsible Agency* FWS Region	FWS Program	Other Agency	Estimated Costs[2] ($1,000) FY1	FY2	FY3	Comments/Notes
A7	Secure habitat through development and implementation of a land protection plan	242	1	5	1	ACQ*			10	30	
							CDFG		25	10	
I13	Conduct habitat surveys to determine possible translocation sites	31	2	3	1	SE*				5	
							CDFG			5	
A7	Secure habitat at Translocation sites through development and implementation of land protection plan	32	2	5	1	ACQ*				20	
							CDFG			20	
M1	Develop propagation techniques, if necessary	33	2	3	1	SE*					
							CDFG				Begin in FY4
I13	Develop translocation techniques	34	2	3	1	SE*					
							CDFG				Begin in FY4
M2	Implement transplant action	35	2	4	1	SE*					
							CDFG				Begin in FY5
M7	Monitor transplanted populations by annual surveys	36	2	Continuous	1	SE*					
							CDFG				Begin in FY5

General Category	Plan Task	Task Number	Priority Number	Task Duration (Years)[1]	Responsible Agency* FWS Region	FWS Program	Other Agency	Estimated Costs[2] ($1,000) FY1	FY2	FY3	Comments/Notes
01	Conduct informational meetings	41	2	As needed	1	SE*		To be determined			
01	Distribute audio-visual program for schools	42	2	1	1	SE				.20	
01	Prepare and distribute local press releases	43	2	As needed	1	SE		To be determined			

* Lead Agency

1 Ongoing = The action is now being implemented and will continue on an annual basis
Continuous = The action will be implemented on an annual basis once the action is begun

2 FY1 = 1985

Abbreviations:
SE = U.S. Fish and Wildlife Service (Endangered Species)
LE = U.S. Fish and Wildlife Service (Law Enforcement)
ACQ = U.S. Fish and Wildlife Service (Acquisition)
CDFG = California Department of Fish and Game

Table 1: List of Agencies Contacted During Agency Review

U.S. Fish an Wildlife Service
Portland, Oregon and Washington, D.C.

California Department of Fish and Game
Sacramento, California

Los Angeles County Museum of Natural History
(Chris Nagano)
Los Angeles, California